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circle results here do not confirm the existence of abnormal changes in the effect of refraction, of any sensible amount, or of more than transitory character, such as may appear in the unsteadiness of the star images under bad conditions.

As a further illustration of the distribution of accidental errors, the count of the residuals from the probable error discussion of the observations of 1914, upon some six hundred faint stars, is tabulated below, in combination with the preceding count. There were twelve hundred residuals in each coordinate, in the comparison of single observations in one position of the instrument, and six hundred in each coordinate, in the comparison of the results in the two positions. The total number of residuals counted is above five thousand. Each group had been treated separately, but the counts are so nearly similar that one tabulation will exhibit the general agreement of observation with theory.

COUNT OF TOTAL NUMBER OF RESIDUALS.

1 p. e.	Count 2522	Theory 2507
1 to 2 times p. e.	" 1593	" 1617
2 to 3 " "	" 676	" 676
3 to 4 " "	" 172	" 180
4 to 5 " "	" 43	" 31
Over 5 " "	" 6	" 3

The larger errors are slightly in excess of the theoretical distribution. The first group, which may be said to define the term "probable error," is less than one per cent in excess of theory.

R. H. TUCKER.

ON THE RADIAL VELOCITIES OF THE ORION NEBULA. (ABSTRACT)

The question of differential motions within the bright-line nebulae has been considered by several astronomers. Keeler's instrumental equipment and methods made the first close approach to detecting such motions, in 1890-91, as Doppler-Fizeau effects. He observed the spectrum of the inner and brighter parts of the *Orion* nebula, chiefly the region preceding the Trapezium, for local broadenings or distortions of the spectrum lines, with negative results. He estimated that differential velocities as great as 8 km./sec. in the brighter parts of the nebular structure would have been detected. It should be said that the results of the last three years, described below, have shown that the variations in the region observed by Keeler do not exceed 8 km./sec.

In 1902 Vogel and Eberhard found evidence of differential velocities in the Orion nebula. Their observed radial velocities

at and slightly east of the brightest star in the Trapezium (θ_1 *Orionis*, or Bond 628) were 5 or 6 km. greater positive than for the bright region lying 0.6 west of the brightest star. Recent results have confirmed these observations.

In 1911-14 Messrs. Buisson, Fabry and Bourget of the University of Marseilles applied the interferometer method to the measurement of radial velocities in the *Orion* nebula with brilliant success. They determined the velocities for 58 points fairly uniformly distributed over a circular area 4 minutes of arc in diameter, with the Trapezium region at the center of this area. They found inequalities of radial speeds amounting to 10 km./sec. for different small parts of the area described. They found also great collective movements for relatively large areas, such that the northeastern part of the circular area is receding with a speed of about 5 km./sec. and the southwestern approaching with a similar speed, both with reference to the speed of the Trapezium region. They concluded that the part of the main nebula observed by them has an apparent rotary movement around a southeast-northwest line, but with numerous local irregularities.

The interferometer method has the great advantage of yielding radial velocity results simultaneously for as many points in the area photographed as the observer pleases to select for measurement—in this case a circular area 4' in diameter—whereas the spectrographic method gives velocities for the exceedingly restricted area which coincides with the slit. It seemed to us important that the interesting results obtained by the interferometer should be confirmed by the usual spectrographic method; and as we were then engaged upon our extensive program of measuring the radial velocities of all available bright-line nebulae we accordingly began upon the *Orion* nebula early in November, 1914. At that and two succeeding oppositions we have obtained about 80 spectrograms for different regions of the nebula, using 3-prism dispersion for the most part, and cameras of 5, 6 and 16 inches focal length, depending upon the brightness of the region selected for observation. Some of the exposures referring to the faint outer structure of the nebula have been many hours in length.

Our results have in general confirmed those of the French observers: the northeastern areas have greater positive velocities than the southwestern areas have; but we are not prepared to say that we are dealing with a rotatory movement of the nebula

as a whole around a northwest-southeast line. There are a great many local irregularities in the observed velocities. The actual motions of the nebulous masses may be of a somewhat local nature.

In particular, we have found that the velocities within 10" of the brightest Trapezium star, Bond No. 628, are 4 or 5 km. greater, recession, than are the velocities in the bright region lying just west of the Trapezium group. It is upon the latter region that most observers have ordinarily placed the slits of their spectrographs.

The detached nebulous mass 7' north and 4' east of the Trapezium is receding from our position in space about 8 km./sec. with reference to the general Trapezium region.

Other detailed results are reserved for a more extensive publication.

The desirability of confirming the interferometer data appealed also to Director Frost of the Yerkes Observatory. The observations secured by Frost and Maney with a 1-prism spectrograph, in January-March, 1915, and already published, are likewise in general confirmation of the Marseilles results.

W. W. CAMPBELL,
J. H. MOORE.

A STUDY OF ABSORPTION EFFECTS IN THE SPIRAL NEBULAE. (ABSTRACT)

It has long been a matter of common knowledge that certain spiral nebulae seen edgewise show a dark lane running down the length of the spiral, generally explained as due to a band of absorbing or occulting matter. The Crossley photographs at present include several hundred spirals, and show that this phenomenon is a very common one. Over sixty spirals give evidence bearing on this characteristic; many of these were shown in lantern slides at the Stanford Meeting of the Pacific Division of the A. A. A. S.; the illustrations will be published in the near future.

A first group of data is formed by the edgewise spirals which give unmistakable evidence of an absorbing lane. The following are the N. G. C. numbers of edgewise spirals showing this phenomenon:

169, 678, 891, 2146, 2968, 3556, 3628, 3718, 4013, 4244, 4282, 4388, 4402, 4517, 4526, 4565, 4594, 4631, 5746, 5866, 5907, 7814.

Considering the proportion of spirals which may be expected